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## Asthma Action Plan Receipt among Children with Asthma 2-17 Years of Age, United States, 2002-2013

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### Abstract

**Objective:** To examine national trends in the receipt of asthma action plans, an intervention recommended by the National Asthma Education and Prevention Program guidelines.

**Study design:** We used data from the sample child component of the National Health Interview Survey from 2002, 2003, 2008, and 2013 to examine the percentage of children 2–17 years of age with asthma ( $n = 3714$ ) that have ever received an asthma action plan. Bivariate and multivariate (with adjustment for sociodemographic characteristics and asthma outcomes consistent with greater disease severity) logistic regressions were conducted to examine trends from 2002 to 2013 and to examine, with 2013 data only, the relationship between having received an asthma action plan and both sociodemographic characteristics and indicators of asthma severity.

**Results:** The percentage of children with asthma that had ever received an asthma action plan increased from 41.7% in 2002 to 50.7% in 2013 ( $P < .001$  for trend). In 2013, a greater percentage of non-Hispanic black (58.4%) than non-Hispanic white (47.4%) children ( $P = .028$ ), privately insured (56.2%) vs those with public insurance only (46.3%) ( $P = .016$ ), and users of inhaled preventive asthma medication vs those that did not ( $P < .001$ ) had ever received an asthma action plan. Adjusted results were similar.

**Conclusion:** The percentage of US children with asthma that had ever received an asthma action plan increased between 2002 and 2013, although one-half had never received an asthma action plan in 2013. Some sociodemographic and asthma severity measures are related to receipt of an asthma action plan.

### Keywords

asthma management plan; asthma action plan; quality of care; children

### Introduction

Asthma affects approximately 7 million children in the US and poses a risk of morbidity that ranges from episodic coughing and wheezing to life-threatening events.<sup>1</sup> In 2009–2010,

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nearly 60% of children with asthma had at least 1 asthma attack, and compared with adults with asthma, children younger than age 18 years of age with asthma had greater rates of visits to their physician's office and the emergency department (ED) for asthma and had similar rates of hospitalizations for asthma.<sup>1</sup> Although prevention of the development of asthma is poorly understood, there are effective means of controlling the symptoms of asthma once it develops, to prevent adverse outcomes.

A central strategy in the management of asthma is symptom monitoring and treatment according to an asthma action plan.<sup>2</sup> The guidelines of the National Asthma Education and Prevention Program (NAEPP) recommend that health care providers develop and provide a written plan for every patient with asthma that includes instructions on asthma trigger avoidance, which medications to take and when to take them, guidance on how to recognize and treat worsening asthma symptoms including adjustment of medications, and when to seek medical care. A written asthma plan not only provides education and information, but it involves the patient directly in self-management.<sup>2</sup> Asthma action plans have been shown to improve asthma-related outcomes<sup>3,4</sup> and are a recognized component of high-quality asthma care.<sup>2,5</sup> Furthermore, Healthy People 2020 Objectives include increasing the proportion of persons with asthma who receive a written asthma action plan.<sup>6</sup>

Nationally representative data on asthma action plan usage seldom have been presented,<sup>7</sup> but previous analyses have suggested that, among adults, the receipt of asthma action plans differs by sociodemographic factors,<sup>2</sup> and, among children, the receipt of asthma action plans may differ by geography.<sup>8</sup> How the receipt of an asthma action plan varies by sociodemographic factors among children is less well studied. Also, to our knowledge, no previous peer-reviewed studies have assessed changes over time in the percentage of children with asthma that have received an asthma action plan.

In this study, we examined trends in the proportion of children that have received an asthma action plan. We also examined associations between receiving an asthma action plan and sociodemographic variables.

## Methods

We used data from the sample child component of the National Health Interview Survey (NHIS) from 2002, 2003, 2008, and 2013. These years of the NHIS included a periodic asthma module that included questions about the receipt of asthma action plans. The NHIS is a nationally representative, cross-sectional survey with a complex sample design and is administered by the National Center for Health Statistics (NCHS). Within each participating family, a sample child 0–17 years of age was selected, and health-related information was obtained from in-person interviews with a knowledgeable adult. Data were from in-house NCHS files, which can be accessed in the NCHS research data center. The final, or unconditional, response rates for the NHIS sample child file ranged from 69.0% in 2013 to 81.3% in 2002.<sup>8</sup> Final, or unconditional, response rates take into account both sample child and family-level participation rates.<sup>9</sup> The NHIS data collection was approved by the NCHS Ethics Review Board. No further review was required for this data analysis.

Receipt of an asthma action plan was determined from questions that changed slightly between survey years 2002/ 2003 and 2008/2013. In 2002/2003, receipt of an asthma action plan was determined by a response of “yes” to the question, “Has a doctor or other health professional EVER given [child’s name] an asthma management plan?” In 2008/2013, the term “asthma action plan” replaced “asthma management plan” (“Has a doctor or other health professional EVER given [child’s name] an asthma action plan?”). These terms have the same meaning and often are used interchangeably.

Covariates explored included age (2–4 years, 5–11 years, 12–17 years), sex, race/ethnicity (non-Hispanic white, non-Hispanic black, non-Hispanic other/multiple race, Puerto Rican, Mexican American, other Hispanic), insurance (any private, public insurance only, uninsured), poverty status, which represents family income as a percentage of the federal poverty level (FPL) (<100%, 100%–<200%, 200%–<400%, 400%), and NCHS urban-rural status codes (large central-metro, large fringe-metro [suburbs], medium/small metro, micropolitan/non-core).<sup>10</sup> Detailed definitions for race/ethnicity, insurance, family income, and NCHS urban rural status are provided in the Appendix.<sup>10–12</sup>

We also included measures of asthma severity. The severity of asthma is an important concept to examine because children affected more adversely by asthma may be more likely to seek care and thus receive an asthma action plan. Asthma severity measures available for all years of data (2002, 2003, 2008, and 2013) included having had an asthma attack in the past 12 months, visit to the ED or urgent care in the past 12 months for asthma, and number of missed school days due to asthma in the past 12 months (0, 1–2, 3–6, 7). These were used in analyses of all years of data. In addition, for 2003, 2008, and 2013, additional asthma severity measures were available for having had an asthma hospitalization visit in the past 12 months and use of preventive asthma medication. Only the 2013 questionnaire, however, contained more detailed responses for frequency of preventive medication use (never, sometimes, every day or almost every day). Therefore, analyses of factors related to receiving an asthma action plan (including asthma severity based on hospitalization and preventive medication use) focused on 2013 data. Preventive asthma medication included both inhaled as well as oral preventive medications and the questions used to identify preventive asthma medication use are provided in the Appendix. These severity measures capture aspects of how severity is measured in the NAEPP asthma guidelines, with measures of impairment (asthma attack in past 12 months, school days missed, preventive asthma medication use) and risk (ED visits and hospitalizations), but the survey recall periods do not match those in the clinical definitions.<sup>2</sup>

## Statistical Analyses

Children <2 years of age were excluded because of difficulty in diagnosing asthma in younger children, when wheezing often is associated with bronchiolitis, or may be a transient rather than chronic condition.<sup>13</sup> For each of the 4 years of data (2002, 2003, 2008, 2013), we estimated the proportion of children with asthma that had received an asthma action plan. Bivariate logistic regression with predictive margins that used receipt of asthma action plan as the dependent variable and survey year as the independent variable was used to identify whether a trend existed across the 4 years (and to estimate the approximate

percentage point change per year). Also, we used multivariable logistic regression, adjusting for variables that were consistent across years, to determine whether changes over time in the percentage of children with asthma receiving asthma action plans were related to changes over time in population demographics or severity of asthma. Covariates included in the multivariable logistic regression were as follows: age group, sex, race/ethnicity, insurance status, poverty status, NCHS urban-rural status, having had an asthma attack in the past year, having visited the ED or urgent care in the past year for asthma, and school days missed in the past year due to asthma.

To examine the relationship between both sociodemographic and asthma severity factors and ever having received an asthma action plan, we restricted the analysis to use of the 2013 data only. The NHIS only provides information on whether the child has ever received an asthma action plan and not whether the asthma action plan is current. Hence, although 2013 data provide the most current data available, the analysis nonetheless identifies factors related to having received an asthma action plan at some point in the child's life. We then conducted both bivariate and multivariable logistic regression by using the dependent variable of reported receipt of an asthma action plan and independent variables of sociodemographic and asthma severity characteristics described above. On the basis of our regression results, interaction terms between race/ethnicity and each of the other variables were considered in multivariable regression.

## Missing Data

Of the 41 050 children between the ages of 2 and 17 years in the 4 years of the survey (2002, 2003, 2008, and 2013), 20 were missing information on whether the child currently had asthma. Of the remaining children, 3898 reported current asthma and were eligible for inclusion. Of those reporting current asthma, 6.5% had missing responses for race/ethnicity that were singly imputed by NCHS. Family income/poverty status was missing for 20.7% of observations, and these responses were multiply imputed by NCHS. Imputed values for race and poverty status were used in all analyses. Whether an asthma action plan had been received, as well as all other covariates used in analyses across all years, were missing for less than 2.7% of records. Joint missingness across all variables resulted in a missing rate of 4.7% and a final analytic sample of 3714 observations.

For 2013 alone, there were 11 425 interviews for children between the ages of 2 and 17 years. Of those, 15 were missing information concerning whether they currently had asthma. Of the remaining children, 1121 reported current asthma and were eligible for inclusion. Of those reporting current asthma, 8.8% were missing data for race/ethnicity, but missing values were singly imputed by NCHS, and these imputations were used in all analyses. Family income/poverty status was missing for 14.4% of observations, but missing values were multiply imputed by NCHS and these imputations were used in all analyses.<sup>14</sup> Whether an asthma action plan had been received, as well as all other covariates used in analyses for 2013 only, were missing for less 1.7% of the data. For 2013 alone, joint missingness across all variables resulted in a missing rate of 3.4% and a final analytic sample of 1083 observations.

## Results

The sociodemographic characteristics of children aged 2–17 years with asthma in the US, for all data years (2002, 2003, 2008, and 2013), and for 2013 alone are presented in Table I. The percentage of children ages 2–17 years with asthma that had ever received an asthma action plan increased from 41.7% in 2002 to 50.7% in 2013 ( $P < .001$  for trend) (Table II). On average, this was approximately a 0.87 percentage point per year increase (CI 0.42–1.33 percentage points per year). After we adjusted for sociodemographic and asthma severity covariates, results were similar, with an increase of approximately 1.04 percentage points per year (CI 0.58–1.50 percentage points per year) ( $P < .001$  for adjusted trend).

In 2013, in unadjusted analysis, significant differences were observed in the percentage of children that had ever received an asthma action plan by some sociodemographic factors and asthma severity indicators (Table III). Specifically, a greater percentage of non-Hispanic black children with asthma had ever received an asthma action plan (58.4%) than non-Hispanic white children (47.4%) ( $P = .028$ ). The percentage of children with asthma that had ever received an asthma action plan in all other terms between race/ethnicity groups was statistically similar to the percentage for non-Hispanic white children with asthma ( $P > .05$  for all comparisons). The percentage of children with asthma with any private insurance that had ever received an asthma action plan (56.2%) was greater than the percentage for those with public insurance only (46.3%) ( $P = .016$ ). The percentage of children with asthma in families with family income  $\geq 400\%$  of FPL that had ever received an asthma action plan (57.2%) was greater than the percentage in families with family income  $<100\%$  of FPL (45.6%) ( $P = .034$ ). The percentage of children with asthma living in large central-metro areas that had ever received an asthma action plan (53.9%) was greater than the percentage for children living in micropolitan and non-core areas (39.9%) ( $P = .022$ ). A greater percentage of children with asthma that had missed  $\geq 7$  days of school due to asthma in the past year had ever received an asthma action plan (67.6%) than children with asthma that had not missed school in the past year (48.1%) ( $P = .002$ ). Finally, a greater percentage of children with asthma that sometimes took an inhaled preventive asthma medication (56.5%) or used an inhaled preventive asthma medication every day or almost every day (63.2%) had ever received an asthma action plan than children that never used an inhaled preventive asthma medication (39.3%) ( $P < .001$  for both comparisons). There were no significant differences in the percentage of children that had ever received an asthma action plan by age group, sex, whether they had had an asthma attack in the past year, whether they had visited an ED or urgent care for asthma in the past year, or whether they had had a hospitalization for asthma during the past year.

After adjustment for all other variables, results were generally similar to unadjusted results with the following exceptions. Uninsured children with asthma were less likely than privately insured children with asthma to have ever received an asthma action plan ( $P = .045$ ). Differences described previously by poverty status, urban-rural status, and days missed from school lost statistical significance. However, point estimates for the percentage of children receiving asthma action plans in categories within each variable exhibited similar patterns both with and without adjustment. Also, interaction terms between race/ethnicity and each of the other variables were explored, but none were found to be significant,

suggesting that the effect of race/ethnicity does not significantly vary across categories of the other variables.

## Discussion

The percentage of children 2–17 years of age in the US that have ever received an asthma action plan increased between 2002 and 2013; however, in 2013, 50.7% of children had ever received an asthma action plan, suggesting that almost one-half of children with asthma have never received an asthma action plan. Adjusting for sociodemographic and asthma severity factors did not change the overall trend, suggesting that changes over time in the percentage of children receiving asthma action plans could not be attributed solely to changes over time in sociodemographics or in the severity of asthma among children with asthma.

In 2013, differences in receipt of an asthma action plan were observed by sociodemographic and asthma severity variables. Both before and after adjustment for other factors, children with private insurance were more likely than those with public insurance to have ever received an asthma action plan, and non-Hispanic black children were more likely to have ever received an asthma action plan than non-Hispanic white children. Finally, both before and after adjustment, children with asthma that took an inhaled preventive asthma medication sometimes, every day, or almost every day were more likely to have ever received an asthma action plan than children that never used an inhaled preventive asthma medication.

That children with private insurance were more likely than those with public insurance to have received an asthma action plan is consistent with many quality-of-care measures that demonstrate greater quality of care with private vs public insurance.<sup>15</sup> Children in families of lower socioeconomic status (SES) tend to rely on public insurance and children in lower SES families also tend to experience lower quality of health care<sup>16–18</sup>; however, it may seem counterintuitive that non-Hispanic black children had significantly greater rates of having ever received an asthma action plan than non-Hispanic white children. Non-Hispanic black children are more often of lower SES than non-Hispanic white children—during 2011, 38.8% of non-Hispanic black children were living below 100% of the FPL compared with 12.5% of non-Hispanic white children.<sup>19</sup> On the other hand, non-Hispanic black children also are more likely to have adverse asthma outcomes related to greater severity of asthma and receiving an action plan may be related to the severity of their disease<sup>1</sup>; however, controlling for factors related to severity did not change the results. In an attempt to further understand these potentially contradictory results, we considered interaction terms in our regression between race/ethnicity and each of the other variables in our multivariable regression, but none were found to be significant. Further exploration may be necessary to fully explain these findings.

Providing an asthma action plan is considered an important component of high-quality asthma care. To increase implementation of the NAEPP asthma guidelines, the National Heart Lung and Blood Institute commissioned a Guideline Implementation Panel that identified the 6 most important aspects of the guidelines including, “All people who have asthma should receive a written asthma action plan to guide their self-management efforts.”<sup>5</sup>



This recommendation was made in the NAEPP guidelines based on extrapolation of clinical trial results.<sup>2</sup> The Guideline Implementation Panel emphasized the role of a written asthma action plan in supporting patients in self-management of chronic disease, in promoting shared decision making between providers and patients, and in improving communication about asthma care between providers, patients, caretakers, and schools.<sup>5</sup>

Researchers have studied previously the effectiveness of asthma action plans<sup>20</sup> and what types of interventions best promote their use<sup>21</sup>; however, the factors associated with the receipt of an asthma action plan have been less studied. In our study, children with preventive asthma medication use were more likely to have received an asthma action plan, but no association was found for other indicators of severity (having an asthma attack, asthma-related visit to the ED, hospitalization for asthma). One explanation for this might be that measures of severity associated with greater intensity of positive health care interventions (preventive asthma medication) also may be indicators of greater quality of care in general (and hence, receipt of asthma action plans). In contrast, other severity measures associated with greater use of emergent health care (ED visits, for example) may be more indicative of poor asthma control and lack of access to quality health care.

Sulaiman et al<sup>22</sup> found some indicators of severity to be associated with having an action plan but others associated with not having an action plan. Specifically, children whose parents reported that their child had moderate or severe asthma were more likely to have an asthma action plan, but children who awoke several nights a week as the result of asthma symptoms were less likely to have an asthma action plan than those that did not.<sup>22</sup> It is not clear to what extent severity of asthma is related to receiving an asthma action plan compared with parental knowledge of the degree of the severity of asthma that may represent access to high-quality asthma care and education.

The findings of our study, as well as that of Sulaiman et al,<sup>22</sup> indicate the difficulty of measuring the severity of asthma and how it relates to the management of asthma in a cross-sectional national survey. In some cases, greater severity of asthma may lead directly to provision of an asthma action plan, which may in turn lead to reduced adverse asthma outcomes. In other cases, however, increased severity of asthma may lead to increased adverse asthma outcomes, which may in turn cause providers to provide an asthma action plan. Without longitudinal data, one cannot distinguish between these situations, which may obfuscate the true effects of asthma severity on asthma management. Furthermore, measures of asthma severity in the NHIS are limited. As a result of these shortcomings, our study is limited by being unable to determine the impact of asthma action plans on asthma outcomes.

This study has other limitations as well. First, although the observed increases in asthma management plan utilization were independent of changes over time in factors that we controlled for in the study (including insurance status and poverty status), we cannot discern which other factors may have contributed to the observed trends. During this time period, many changes in the health system have occurred, including increased usage of electronic health records and many new quality-of-care initiatives, but data available from the NHIS do not allow analysis of the effects of these and other factors. Second, the prevalence of asthma action plan receipt was based on recall rather than review of medical records; however, recall

of asthma action plan receipt does indicate that the adult respondent (in most cases, a parent) does remember the plan, and thus may be an indicator of effective communication with a health care provider about asthma management. This understanding by patients with asthma and their caretakers is the underlying purpose of providing asthma action plans.<sup>2</sup> Third, the NHIS questions ask whether children have ever been given an asthma action plan, but it is unknown whether the asthma action plans are recent and up-to-date. Similarly, it is unknown whether the child complied with the asthma action plan. Furthermore, although the change in terminology from asthma management plan to asthma action plan was consistent with the interchangeability of terminology used in clinical medicine, it is possible that differences over time could, in part, be due to the change in the terminology used in the question. We believe this is unlikely because a description of an asthma action/management plan is provided to the survey respondent.

The percentage of US children with asthma that have ever received an asthma action plan increased between 2002 and 2013. However, in 2013, nearly one-half of children with asthma had never received an asthma action plan. Furthermore, in 2013, children with private insurance compared with public insurance, non-Hispanic black children compared with non-Hispanic white children, and children receiving preventive asthma medication were more likely to have ever received an asthma action plan.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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## Abbreviations:

|              |                                                  |
|--------------|--------------------------------------------------|
| <b>ED</b>    | Emergency department                             |
| <b>FPL</b>   | Federal poverty levels                           |
| <b>NAEPP</b> | National Asthma Education and Prevention Program |
| <b>NCHS</b>  | National Center for Health Statistics            |
| <b>NHIS</b>  | National Health Interview Survey                 |
| <b>SE</b>    | Standard Error                                   |

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**Table I.**

Characteristics of children aged 2–17 years with asthma, US, 2002–2013 (selected years)

| Sociodemographic Characteristics                      | % distribution among children with asthma 2002, 2003, 2008, and 2013 (SE) (n=3,714) | % distribution among children with asthma, 2013 only (SE) (n=1,083) |
|-------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| <b>Age, y</b>                                         |                                                                                     |                                                                     |
| 2–4                                                   | 12.9 (0.7)                                                                          | 10.4 (1.2)                                                          |
| 4–11                                                  | 46.7 (1.1)                                                                          | 48.2 (2.0)                                                          |
| 12–17                                                 | 40.4 (1.1)                                                                          | 41.4 (2.1)                                                          |
| <b>Sex</b>                                            |                                                                                     |                                                                     |
| Male                                                  | 58.6 (1.0)                                                                          | 56.8 (2.1)                                                          |
| Female                                                | 41.4 (1.0)                                                                          | 43.2 (2.1)                                                          |
| <b>Race/Ethnicity</b>                                 |                                                                                     |                                                                     |
| Non-Hispanic white                                    | 53.3 (1.1)                                                                          | 47.3 (2.1)                                                          |
| Non-Hispanic black                                    | 22.6 (0.9)                                                                          | 22.0 (1.6)                                                          |
| Non-Hispanic other/multiple race                      | 7.8 (0.6)                                                                           | 8.7 (1.1)                                                           |
| Puerto Rican                                          | 3.7 (0.4)                                                                           | 4.4 (0.9)                                                           |
| Mexican American                                      | 8.7 (0.6)                                                                           | 11.7 (1.1)                                                          |
| Other Hispanic                                        | 4.0 (0.3)                                                                           | 5.9 (0.8)                                                           |
| <b>Insurance</b>                                      |                                                                                     |                                                                     |
| Any private insurance                                 | 53.7 (1.1)                                                                          | 45.2 (2.1)                                                          |
| Public insurance only                                 | 37.7 (1.1)                                                                          | 47.3 (2.1)                                                          |
| Other insurance                                       | 2.3 (0.3)                                                                           | 2.1 (0.6) *                                                         |
| Uninsured                                             | 6.3 (0.5)                                                                           | 5.4 (0.9)                                                           |
| <b>Poverty status (ratio of family income to FPL)</b> |                                                                                     |                                                                     |
| 400%                                                  | 24.2 (0.9)                                                                          | 20.4 (1.7)                                                          |
| 200% – <400%                                          | 29.4 (1.0)                                                                          | 26.7 (1.9)                                                          |
| 100– <200%                                            | 22.3 (0.9)                                                                          | 21.5 (1.7)                                                          |
| <100%                                                 | 24.2 (0.9)                                                                          | 31.3 (2.0)                                                          |
| <b>Urban-Rural Status</b>                             |                                                                                     |                                                                     |
| Large central-metro                                   | 26.7 (1.0)                                                                          | 27.4 (1.8)                                                          |
| Large fringe-metro                                    | 25.8 (1.1)                                                                          | 27.2 (2.1)                                                          |
| Medium and small metro                                | 32.2 (1.3)                                                                          | 30.4 (2.2)                                                          |
| Micropolitan and non-core                             | 15.4 (1.0)                                                                          | 15.0 (1.6)                                                          |
| <b>Asthma attack in last year</b>                     |                                                                                     |                                                                     |
| No                                                    | 40.5 (1.0)                                                                          | 42.2 (1.9)                                                          |
| Yes                                                   | 59.5 (1.0)                                                                          | 57.8 (1.9)                                                          |
| <b>ED/urgent care visit for asthma in last 12 mo</b>  |                                                                                     |                                                                     |
| No                                                    | 81.3 (0.8)                                                                          | 80.0 (1.5)                                                          |
| Yes                                                   | 18.7 (0.8)                                                                          | 20.0 (1.5)                                                          |
| <b>Asthma hospitalizations in last 12 months</b>      |                                                                                     |                                                                     |
| No                                                    | N/A                                                                                 | 95.7 (0.8)                                                          |
| Yes                                                   | N/A                                                                                 | 4.4 (0.8)                                                           |

| Sociodemographic Characteristics                | % distribution among children with asthma 2002, 2003, 2008, and 2013 (SE) (n=3,714) | % distribution among children with asthma, 2013 only (SE) (n=1,083) |
|-------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| <b>School days missed for asthma</b>            |                                                                                     |                                                                     |
| 0                                               | 60.0 (1.0)                                                                          | 49.3 (2.0)                                                          |
| 1–2                                             | 14.1 (0.7)                                                                          | 24.0 (1.8)                                                          |
| 3–6                                             | 15.0 (0.7)                                                                          | 17.2 (1.5)                                                          |
| 7+                                              | 10.8 (0.6)                                                                          | 9.4 (1.1)                                                           |
| <b>Preventive Asthma Medication (2013 only)</b> |                                                                                     |                                                                     |
| Never                                           | N/A                                                                                 | 45.1 (2.1)                                                          |
| Sometimes                                       | N/A                                                                                 | 24.8 (1.6)                                                          |
| Every day or almost every day                   | N/A                                                                                 | 30.0 (2.0)                                                          |

N/A: indicates variables not available across all 4 survey years

\* data are not statistically reliable due to less than 30 observations

**Table II:**

Unadjusted and Adjusted rates of asthma management plans among children aged 2–17 years with asthma, US, 2002–2013

|                                                             | Unadjusted (SE)          | Adjusted (SE) <sup>*</sup> |
|-------------------------------------------------------------|--------------------------|----------------------------|
| <b>Average percentage point increase per year 2002–2013</b> | <b>0.87 <sup>†</sup></b> | <b>1.07 <sup>†</sup></b>   |
| 2002                                                        | 41.7 (2.0)               | 39.6 (1.4)                 |
| 2003                                                        | 40.5 (1.9)               | 40.7 (1.3)                 |
| 2008                                                        | 45.2 (2.4)               | 46.0 (1.1)                 |
| 2013                                                        | 50.7 (2.1)               | 51.5 (2.0)                 |

<sup>\*</sup> Adjusted percentage is adjusted for sex, race/ethnicity, insurance status, poverty status, NCHS urban-rural status, having had an asthma attack in the past year, having visited the ED or urgent care in the past year for asthma, days missed of school due to asthma.

<sup>†</sup> p<0.001 for trend over time

**Table III.**

Unadjusted and adjusted percentages of children aged 2–17 years with asthma with an asthma action/management plan (AAP), 2013

| Socioeconomic and demographic characteristics     | Unadjusted percentages (SE) of children with an AAP | Unadjusted percentages (SE) of children with an AAP | Unadjusted percentages (SE) of children without an AAP | Adjusted percentages (SE) of children without an AAP |
|---------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|--------------------------------------------------------|------------------------------------------------------|
| Age, y                                            |                                                     |                                                     |                                                        |                                                      |
| 2–4 (Ref)                                         | 48.2 (6.3)                                          | 46.7 (5.8)                                          | 51.8 (6.3)                                             | 53.3 (5.8)                                           |
| 5–11                                              | 49.0 (3.1)                                          | 49.4 (2.9)                                          | 51.0 (3.1)                                             | 50.6 (2.9)                                           |
| 12–17                                             | 53.4 (3.0)                                          | 53.3 (2.9)                                          | 46.6 (3.0)                                             | 46.7 (2.9)                                           |
| Sex                                               |                                                     |                                                     |                                                        |                                                      |
| Male (Ref)                                        | 51.2 (2.7)                                          | 49.8 (2.5)                                          | 48.8 (2.7)                                             | 50.2 (2.5)                                           |
| Female                                            | 50.1 (3.3)                                          | 52.0 (2.9)                                          | 49.9 (3.3)                                             | 48.0 (2.9)                                           |
| Race/ethnicity                                    |                                                     |                                                     |                                                        |                                                      |
| Non-Hispanic white (Ref)                          | 47.4 (3.4)                                          | 46.1 (3.4)                                          | 52.6 (3.4)                                             | 53.9 (3.4)                                           |
| Non-Hispanic black                                | 58.4 (3.7) *                                        | 60.4 (3.5) †                                        | 41.6 (3.7) *                                           | 39.6 (3.5) †                                         |
| Non-Hispanic other/multiple race                  | 43.3 (6.0)                                          | 44.4 (5.6)                                          | 56.7 (6.0)                                             | 55.6 (5.6)                                           |
| Puerto Rican                                      | 49.9 (10.1)                                         | 50.7 (9.0)                                          | 50.1 (10.1)                                            | 49.3 (9.0)                                           |
| Mexican American                                  | 54.2 (5.1)                                          | 54.9 (4.6)                                          | 45.8 (5.1)                                             | 45.1 (4.6)                                           |
| Other Hispanic                                    | 53.4 (6.9)                                          | 53.0 (6.7)                                          | 46.6 (6.9)                                             | 47.0 (6.7)                                           |
| Insurance <sup>a</sup>                            |                                                     |                                                     |                                                        |                                                      |
| Any private insurance (Ref)                       | 56.2 (3.1)                                          | 58.0 (3.3)                                          | 43.8 (3.1)                                             | 42.0 (3.3)                                           |
| Public insurance only                             | 46.3 (2.9) *                                        | 44.5 (3.1) †                                        | 53.7 (2.9) *                                           | 55.5 (3.1) †                                         |
| Uninsured                                         | 43.1 (7.8)                                          | 42.0 (7.0) *                                        | 56.9 (7.8)                                             | 58.0 (7.0) *                                         |
| Poverty status (ratio family income to FPL)       |                                                     |                                                     |                                                        |                                                      |
| 400% (Ref)                                        | 57.2 (4.3)                                          | 52.4 (4.6)                                          | 42.8 (4.3)                                             | 47.6 (4.6)                                           |
| 200%–<400%                                        | 49.5 (4.1)                                          | 47.3 (3.8)                                          | 50.5 (4.1)                                             | 52.7 (3.8)                                           |
| 100%–<200%                                        | 53.7 (4.4)                                          | 55.2 (4.0)                                          | 46.3 (4.4)                                             | 44.8 (4.0)                                           |
| <100%                                             | 45.6 (3.8) *                                        | 49.5 (4.1)                                          | 54.4 (3.8) *                                           | 50.5 (4.1)                                           |
| Urban-rural status                                |                                                     |                                                     |                                                        |                                                      |
| Large central-metro (Ref)                         | 53.9 (3.5)                                          | 52.7 (3.5)                                          | 46.1 (3.5)                                             | 47.3 (3.5)                                           |
| Large fringe-metro                                | 52.3 (4.4)                                          | 51.4 (4.1)                                          | 47.7 (4.4)                                             | 48.6 (4.1)                                           |
| Medium and small metro                            | 51.9 (3.8)                                          | 52.8 (3.7)                                          | 48.1 (3.8)                                             | 47.2 (3.7)                                           |
| Micropolitan and non-core                         | 39.9 (5.0) *                                        | 41.6 (4.4)                                          | 60.1 (5.0) *                                           | 58.4 (4.4)                                           |
| Asthma attack in last year                        |                                                     |                                                     |                                                        |                                                      |
| No                                                | 46.7 (3.0)                                          | 47.7 (3.1)                                          | 53.3 (3.0)                                             | 52.3 (3.1)                                           |
| Yes                                               | 53.3 (3.0)                                          | 53.0 (2.7)                                          | 46.3 (2.9)                                             | 47.0 (2.7)                                           |
| ED/Urgent care visit for asthma in last 12 months |                                                     |                                                     |                                                        |                                                      |
| No                                                | 48.8 (2.4)                                          | 50.1 (2.3)                                          | 51.2 (2.4)                                             | 49.9 (2.3)                                           |
| Yes                                               | 58.5 (4.4)                                          | 53.4 (4.7)                                          | 41.5 (4.4)                                             | 46.6 (4.7)                                           |
| Asthma hospitalizations in last year              |                                                     |                                                     |                                                        |                                                      |



| Socioeconomic and demographic characteristics | Unadjusted percentages (SE) of children with an AAP | Unadjusted percentages (SE) of children with an AAP | Unadjusted percentages (SE) of children without an AAP | Adjusted percentages (SE) of children without an AAP |
|-----------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|--------------------------------------------------------|------------------------------------------------------|
| No                                            | 50.4 (2.2)                                          | 50.8 (2.0)                                          | 49.6 (2.2)                                             | 49.2 (2.0)                                           |
| Yes                                           | 58.5 (8.9)                                          | 49.1 (8.7)                                          | 41.5 (8.9)                                             | 50.9 (8.7)                                           |
| School days missed for asthma                 |                                                     |                                                     |                                                        |                                                      |
| 0 (Ref)                                       | 48.1 (3.0)                                          | 50.5 (2.8)                                          | 51.9 (3.0)                                             | 49.5 (2.8)                                           |
| 1–2                                           | 45.7 (4.1)                                          | 46.9 (4.0)                                          | 54.3 (4.1)                                             | 53.1 (4.0)                                           |
| 3–6                                           | 56.2 (4.9)                                          | 51.3 (4.7)                                          | 43.8 (4.9)                                             | 48.7 (4.7)                                           |
| 7+                                            | 67.6 (5.3) <sup>†</sup>                             | 61.3 (5.9)                                          | 32.4 (5.3) <sup>†</sup>                                | 38.7 (5.9) <sup>†</sup>                              |
| Preventive asthma medication use frequency    |                                                     |                                                     |                                                        |                                                      |
| Never (Ref)                                   | 39.3 (3.1) <sup>†</sup>                             | 39.8 (2.9)                                          | 60.7 (3.1)                                             | 60.2 (2.9)                                           |
| Sometimes                                     | 56.5 (3.7) <sup>†</sup>                             | 56.4 (3.7) <sup>†</sup>                             | 43.5 (3.7) <sup>†</sup>                                | 43.6 (3.7) <sup>†</sup>                              |
| Every day or almost every day                 | 63.2 (3.7) <sup>†</sup>                             | 62.5 (3.5) <sup>†</sup>                             | 36.8 (3.7) <sup>†</sup>                                | 37.5 (3.5) <sup>†</sup>                              |

\* P < .05 for comparison to reference group.

<sup>†</sup> P < .01 for comparison with the reference group.

<sup>a</sup> Other insurance (n = 22) and missing insurance status (n = 6) both with and without asthma management plans not shown.